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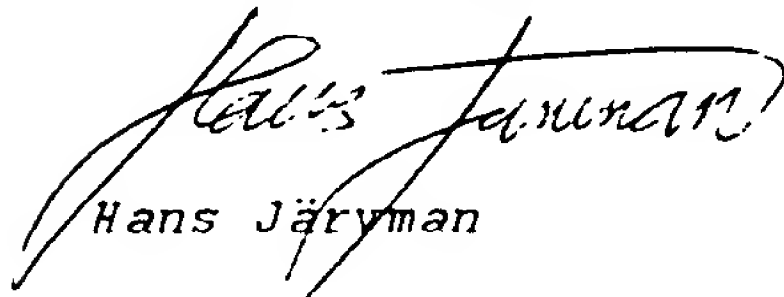
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Avgift  
Fee

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# Cemented carbide insert for turning, milling and drilling

The present invention relates to a cemented carbide cutting tool insert, particularly useful for turning, milling and drilling in steels and stainless steels.

Conventional cemented carbide inserts are produced by powder metallurgical methods including milling of a powder mixture forming the hard constituents and the binder phase, pressing and sintering. The milling operation is an intensive milling in mills of different sizes and with the aid of milling bodies. The milling time is of the order of several hours up to several days. Such processing is believed to be necessary in order to obtain a uniform distribution of the binder phase in the milled mixture. It is further believed that the intensive milling creates a reactivity of the mixture which further promotes the formation of a dense structure. However, milling has its disadvantages. During the long milling time the milling bodies are worn and contaminate the milled mixture. Furthermore even after an extended milling a random rather than an ideal homogeneous mixture may be obtained. Thus, the properties of the sintered cemented carbide containing two or more components depend on how the starting materials are mixed.

There exist alternative technologies to intensive milling for production of cemented carbide, for example, use of particles coated with binder phase metal. The coating methods include fluidized bed methods, solgel techniques, electrolytic coating, PVD coating or other methods such as disclosed in e. g. GB 346,473, SE 502 754 or US 5,505,902. Coated carbide particles could be mixed with additional amounts of cobalt and other carbide powders to obtain the desired final material composition, pressed and sintered to a dense structure.

During metal cutting operations like turning, milling and drilling the general properties such as hardness, resistance against plastic deformation, resistance against formation of thermal fatigue cracks are to a great extent related to the volume fraction of the hard phases and the binder phase in the sintered cemented carbide body. It is well known that increasing the amount of the binder phase reduces the resistance to

plastic deformation. Different cutting conditions require different properties of the cutting insert. When cutting in steels with raw surface zones (e. g. rolled, forged or cast) a coated cemented carbide insert must consist of tough cemented carbide and have a very good coating adhesion as well. When turning, milling or drilling in low alloyed steels or stainless steels the adhesive wear is generally the dominating wear type.

Measures can be taken to improve the cutting performance with respect to a specific wear type. However, very often such action will have an negative effect on other wear properties.

The influence of some possible measures is given below :

1. Milling, turning or drilling at high cutting speeds and high cutting edge temperature require a cemented carbide with a rather large amount of cubic carbides (a solid solution of WC-TiC-TaC-NbC). Thermal fatigue cracks will often more easily develop in such carbides.

2. The formation of thermal fatigue cracks can be reduced by lowering the binder phase content. However, such action will lower the toughness properties of the cutting insert which is not desirable.

3. Improved abrasive wear can be obtained by increasing the coating thickness. However, thick coatings increase the risk for flaking and will lower the resistance to adhesive wear.

It has now surprisingly been found that cemented carbide inserts made from powder mixtures with hard constituents with narrow grain size distributions and without conventional milling have excellent cutting performance in steels and stainless steels with or without raw surfaces in turning, milling and drilling under both dry and wet conditions.

Fig 1 shows in 1200X the microstructure of a cemented carbide insert according to the invention.

Fig 2 shows in 1200X the microstructure of a corresponding insert made according to prior art.

According to the invention there is now provided cemented carbide inserts with excellent properties for machining of steels and stainless steels comprising WC and 4 - 20 wt-% Co, preferably 5 - 12.5 wt-% Co and 0 - 30 wt-% cubic carbide, preferably 0 - 15 wt-% cubic carbide, most preferably 0 - 10

wt-% cubic carbide such as TiC, TaC, NbC or mixtures thereof. The WC-grains have an average grain size in the range 0.8 - 3.5  $\mu\text{m}$ , preferably 1.0 - 3.0  $\mu\text{m}$ . The microstructure of the cemented carbide according to the invention is further characterized by  
 5 a narrow grain size distribution of WC in the range 0.5 - 4.5  $\mu\text{m}$ , and a lower tendency for the cubic carbide particles, when present, to form long range skeleton, compared to conventional cemented carbide.

In another alternative embodiment there is provided ce-  
 10 mented carbide inserts comprising WC and 10 - 25 wt-% Co, preferably 15 - 20 wt-% Co, and < 2 wt-%, preferably < 1 wt-% cubic carbides such as  $\text{Cr}_3\text{C}_2$  and/or VC added as grain growth inhibitors. The WC-grains have an average grain size 0.5 - 1.0  $\mu\text{m}$ . The microstructure of cemented carbide according to the in-  
 15 vention is further characterized by a narrow grain size distribution of WC in the range 0 - 1.5  $\mu\text{m}$ .

The amount of W dissolved in binder phase is controlled by adjustment of the carbon content by small additions of carbon black or pure tungsten powder. The W-content in the binder  
 20 phase can be expressed as the "CW ratio" defined as

$$\text{CW-ratio} = M_s / (\text{wt}\% \text{Co} \cdot 0.0161)$$

where  $M_s$  is the measured saturation magnetization of the sintered cemented carbide body in kA/m and wt% Co is the weight percentage of Co in the cemented carbide. The CW-ratio in  
 25 inserts according to the invention shall be 0.82 - 1.0, preferably 0.86 - 0.96.

The sintered inserts according to the invention are used coated or uncoated, preferably coated with MTCVD, conventional CVD or PVD with or without  $\text{Al}_2\text{O}_3$ . In particular, multilayer  
 30 coatings comprising  $\text{TiC}/\text{Nb}_2\text{O}_5$  with columnar grains followed by a layer of  $\alpha\text{-Al}_2\text{O}_3$ ,  $\kappa\text{-Al}_2\text{O}_3$  or a mixture of  $\alpha$  and  $\kappa\text{-Al}_2\text{O}_3$ , have shown good results. In another preferred embodiment the coating described above is completed with a TiN layer which could be brushed or used without brushing.

According to the method of the present invention WC powder with a narrow grain size distribution is wet mixed without  
 35 milling with deagglomerated powder of other carbides generally

TiC, TaC and/or NbC, binder metal and pressing agent, dried preferably by spray drying, pressed to inserts and sintered.

WC-powder with a narrow grain size distributions according to the invention with eliminated coarse grain tails  $> 4.5 \mu\text{m}$  and with eliminated fine grain tails,  $< 0.5 \mu\text{m}$ , are prepared by sieving such as in a jetmill-classifier. It is essential according to the invention that the mixing takes place without milling i.e. there should be no change in grain size or grain size distribution as a result of the mixing.

Hard constituents with narrow grain size distributions according to the alternative embodiment with eliminated coarse grain tails  $> 1.5 \mu\text{m}$  are prepared by sieving such as in a jetmill classifier. It is essential according to the invention that the mixing takes place without milling i.e. there should be no change in grain size or grain size distribution as a result of the mixing.

In a preferred embodiment the hard constituents, at least those with narrow grain size distribution, are after careful deagglomeration coated with binder metal using methods disclosed in patent US 5,505,902 or Swedish patent SE 502 754. In such case the cemented carbide powder according to the invention consists preferably of Co-coated WC + Co-binder, with or without additions of the cubic carbides, TiC, TaC, NbC, (Ti,W)C, (Ta,Nb)C, (Ti,Ta,Nb)C, (W,Ta,Nb)C, (W,Ti,Ta,Nb)C or  $\text{Cr}_3\text{C}_2$  and/or VC coated or uncoated, preferably uncoated, possibly with further additions of Co-powder in order to obtain the desired final composition.

#### Example 1

A. Cemented carbide tool inserts of the type SEMN 1204 AZ, an insert for milling, with the composition 9.1 wt% Co, 1.23 wt% TaC and 0.30 wt% NbC and rest WC with a grain size of  $1.6 \mu\text{m}$  were produced according to the invention. Cobalt coated WC, WC-2 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment, mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C and TaC powders to obtain the desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l

fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with carbon black to a binder phase highly alloyed with W corresponding to a CW-ratio of 0.89. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained, Fig 1.

Before coating a negative chamfer with the angle of  $20^\circ$  was ground around the whole insert.

The inserts were coated with a  $0.5\ \mu\text{m}$  equiaxed TiCN-layer (with a high nitrogen content corresponding to an estimated C/N-ratio of 0.05) followed by a  $4\ \mu\text{m}$  thick TiCN-layer with columnar grains by using MTCVD-technique (temperature  $885\text{--}850\ ^\circ\text{C}$  and  $\text{CH}_3\text{CN}$  as the carbon and nitrogen source). In subsequent steps during the same coating cycle, a  $1.0\ \mu\text{m}$  thick layer of  $\text{Al}_2\text{O}_3$  was deposited using a temperature  $970\ ^\circ\text{C}$  and a concentration of  $\text{H}_2\text{S}$  dopant of 0.4 % as disclosed in EP-A-523 021. A thin ( $0.3\ \mu\text{m}$ ) layer of TiN was deposited on top according to known CVD-technique. XRD-measurement showed that the  $\text{Al}_2\text{O}_3$ -layer consisted of 100 %  $\kappa$ -phase.

The coated inserts were brushed by a nylon straw brush containing SiC grains. Examination of the brushed inserts in a light microscope showed that the thin TiN-layer had been brushed away only along the cutting edge leaving there a smooth  $\text{Al}_2\text{O}_3$ -layer surface.

Coating thickness measurements on cross sectioned brushed samples showed no reduction of the coating along the edge line except for the outer TiN-layer that was removed.

B. Cemented carbide tool inserts of the type SEMN 1204 AZ with the same chemical composition, average grain size of WC, CW-ratio, chamfering and CVD-coating respectively but produced from powder manufactured with conventional ball milling techniques, Fig. 2, were used as reference for comparison with the test specimens according to above.

Inserts from A were compared to inserts from B in a wet milling test in a medium alloyed steel (HB=210) with hot rolled and rusty surfaces. Two parallel bars each of a thickness of 34



mm were central positioned relatively the cutter body (diameter 100 mm), and the bars were placed with an air gap of 10 mm between them.

The cutting data were :

5

Speed= 160 m/min

Feed= 0.20 mm/rev

Cutting depth= 2 mm, single tooth milling with coolant.

Evaluated life length of variant A according to the invention was 3600 mm and for the standard variant B only 2400 mm.

10

Since the CW-ratio, the negative chamfer and the coatings were equal for variants A and B, the differences in cutting performance depend on the improved properties obtained by the invention.

## 15 Example 2

A. Cemented carbide tool inserts of the type SEMN 1204 AZ according to the invention identical to the test specimen (A) in Example 1.

20

B. Cemented carbide tool inserts of the type SEMN 1204 AZ identical to the reference specimen (B) in Example 1.

25

C. A strongly competitive cemented carbide grade of the type SEKN 1204 from an external leading carbide producer with the composition 7.5 wt-% Co, 0.4 wt-% TaC, 0.1 wt% NbC, 0.3 wt% TiC rest WC and a CW-ratio of 0.95. The insert was provided with a coating consisting of a 0.5  $\mu\text{m}$  equiaxed TiCN-layer, 2.1  $\mu\text{m}$  columnar TiCN-layer, 2.2  $\mu\text{m}$   $\text{N-Al}_2\text{O}_3$ -layer and a 0.3  $\mu\text{m}$  TiN-layer.

30

Inserts from A were compared against inserts from B and C in a dry milling test in a low alloyed steel (HB=300) with pre machined surfaces. A bar with a thickness of 180 mm were central positioned relatively the cutter body (diameter 250 mm)

The cutting data were:

Speed= 150 m/min,

Feed= 0.23 mm/rev

35

Cutting depth= 2 mm, single tooth milling dry conditions.

Insert B broke after 6000 mm after comb crack formation and chipping and insert C broke after 4800 mm by a similar wear

pattern. Finally, insert A according to the invention broke after 8000 mm.

### Example 3

5 A. Cemented carbide tool inserts of the type CNMG 120408-QM, an insert for turning, with the composition 8.0 wt% Co, and rest WC with a grain size of 3.0  $\mu\text{m}$  were produced according to the invention. Cobalt coated WC, WC-8 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with carbon black to a binder phase alloyed with W corresponding to a CW-ratio of 15 0.93. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

20 The inserts were coated with conventional CVD TiN+TiCN, 1+1  $\mu\text{m}$ .

B. Cemented carbide tool inserts of the type CNMG 120408-QM with the same chemical composition, average grain size of WC, CW-ratio and the same CVD-coating respectively but produced from powder manufactured with conventional ball milling techniques were used as reference for comparison with the test specimens according to above

30 Inserts from A and B were compared in a face turning test where the resistance against plastic deformation was measured as the flank wear. The work piece material was a rather highly alloyed steel, a bar with diameter 180 mm (HB=310). The cutting data were:

Speed= 290 m/min

Feed= 0.30 mm/rev

Depth of cut= 2 mm

35 The flank wear after two passages (average for 3 edges per variant) was found to be 0.27 mm for variant A according to the invention and 0.30 for variant B.



Example 4

A. Cemented carbide tool inserts of the type CNMG120408-MM, an insert for turning, with the composition 10.5 wt-% Co, 1.16 wt-% Ta, 0.28 wt-% Nb and rest WC with a grain size of 1.6  $\mu\text{m}$  were produced according to the invention. Cobalt coated WC, WC-6 wt% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment, mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C and TaC powders to obtain desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with carbon black to a binder phase highly alloyed with W corresponding to a CW-ratio of 0.87. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 0.5  $\mu\text{m}$  equiaxed TiCN-layer with a high nitrogen content, corresponding to an estimated C/N ratio of 0.05, followed by a 4.2  $\mu\text{m}$  thick layer of columnar TiCN deposited using MT-CVD technique. In subsequent steps during the same coating process a 1.0  $\mu\text{m}$  layer of  $\text{Al}_2\text{O}_3$  consisting of pure  $\kappa$ -phase according to procedure disclosed in EP-A-523 021. A thin, 0.5  $\mu\text{m}$ , TiN layer was deposited, during the same cycle, on top of the  $\text{Al}_2\text{O}_3$ -layer.

The coated insert was brushed by a SiC containing nylon straw brush after coating, removing the outer TiN layer on the edge.

B. Cemented carbide tool inserts of the type CNMG120408-MM with the same chemical composition, average grain size of WC, CW-ratio and the same CVD-coating respectively but produced from powder manufactured with conventional ball milling techniques were used as reference for comparison with the test specimens according to above.

Inserts from A and B were compared in facing of a bar, diameter 180, with two, opposite, flat sides (thickness 120 mm) in 4LR60 material (a stainless steel).

The cutting data were:

Feed= 0.25 mm/rev,

Speed= 180 m/min and

Depth of cut= 2.0 mm.

5 The wear mechanism in this test is chipping of the edge.

#### Result

Insert	Number of cuts
A, according to the invention	19
B	15

#### Example 5

A. Cemented carbide turning tool inserts of the type  
 10 CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta,  
 2.06 wt-% Nb, 2.04 wt% Ti and rest WC with a grain size of 1.6  
 $\mu\text{m}$  were produced according to the invention. Cobalt coated WC,  
 WC-5 wt% Co, prepared according to US 5,505,902 was carefully  
 15 deagglomerated in a laboratory jetmill equipment, mixed with  
 additional amounts of Co and deagglomerated uncoated (Ta,Nb)C,  
 TaC and (Ti,W)C powders to obtain desired material composition.  
 The mixing was carried out in an ethanol and water solution  
 (0.25 l fluid per kg cemented carbide powder) for 2 hours in a  
 laboratory mixer and the batch size was 10 kg. Furthermore, 2  
 20 wt% lubricant, was added to the slurry. The carbon content was  
 adjusted with tungsten powder to a binder phase alloy<sup>3</sup> with W  
 corresponding to a CW-ratio of 0.95. After spray drying, the  
 inserts were pressed and sintered according to standard  
 practise and dense structures with no porosity were obtained.  
 25 The inserts were coated with an innermost 5  $\mu\text{m}$  layer of  
 TiCN, followed by in subsequent steps during the same coating  
 process a 6  $\mu\text{m}$  layer of  $\text{Al}_2\text{O}_3$ .

B. Cemented carbide turning tool inserts of the type  
 CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta,  
 30 2.06 wt-% Nb, 2.04 wt% Ti and rest WC with a grain size of 1.6  
 $\mu\text{m}$  were produced according to the invention. Uncoated deagglo-  
 merated WC was mixed with additional amounts of Co and deagglo-  
 merated uncoated (Ta,Nb)C, TaC and (Ti,W)C powders to obtain  
 a desired material composition. The mixing was carried out in  
 35 an ethanol and water solution (0.25 l fluid per kg cemented

carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt% lubricant, was added to the slurry. The carbon content was adjusted with tungsten powder to a binder phase alloyed with W corresponding to a CW-ratio of 0.95. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 5 µm layer of TiCN, followed by in subsequent steps during the same coating process a 6 µm layer of Al<sub>2</sub>O<sub>3</sub>.

C. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt% Ti and rest WC produced from powder manufactured with conventional ball milling techniques with the same CW-ratio and almost the same average WC-grain size as insert A and B were coated with the same coating as insert A and B.

Inserts from A, B and C were compared in an external longitudinal turning test with cutting speed 220 m/min and 190 m/min resp., a depth of cut of 2 mm, and a feed per tooth equal to 0.7 mm/revolution. The work piece material was SS 2541 with a hardness of 300 HB and a diameter of 160 mm. The wear criteria in this test was the measure of the edge depression in µm, which reflects the inverse resistance against plastic deformation. A lower value of the edge depression indicates higher resistance against plastic deformation.

The following results were obtained :

	v= 190 m/min	v=220 m/min
	edge depression, µm	edge depression, µm
A	59	85
B	56	93
C	89	116

30  
35

Since the general toughness behaviour was similar it is clear that both insert A produced from Co-coated WC and insert B produced from uncoated WC both according to the invention, performed better than insert C produced with conventional techniques.

Example 6

A. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt-% Ti and rest WC with a grain size of 1.6  $\mu\text{m}$  were produced according to the invention. Cobalt coated WC, WC-5 wt-% Co, prepared according to US 5,505,902 was carefully deagglomerated in a laboratory jetmill equipment, mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C, TaC and (Ti,W)C powders to obtain desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt-% lubricant, was added to the slurry. The carbon content was adjusted with tungsten powder to a binder phase alloyed with W corresponding to a CW-ratio of 0.95. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 5  $\mu\text{m}$  layer of TiCN, followed by in subsequent steps during the same coating process a 6  $\mu\text{m}$  layer of  $\text{Al}_2\text{O}_3$ .

B. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt-% Ti and rest WC with a grain size of 1.6  $\mu\text{m}$  were produced according to the invention. Uncoated deagglomerated WC was mixed with additional amounts of Co and deagglomerated uncoated (Ta,Nb)C, TaC and (Ti,W)C powders to obtain desired material composition. The mixing was carried out in an ethanol and water solution (0.25 l fluid per kg cemented carbide powder) for 2 hours in a laboratory mixer and the batch size was 10 kg. Furthermore, 2 wt-% lubricant, was added to the slurry. The carbon content was adjusted with tungsten powder to a binder phase alloyed with W corresponding to a CW-ratio of 0.95. After spray drying, the inserts were pressed and sintered according to standard practise and dense structures with no porosity were obtained.

The inserts were coated with an innermost 5  $\mu\text{m}$  layer of TiCN, followed by in subsequent steps during the same coating process a 6  $\mu\text{m}$  layer of  $\text{Al}_2\text{O}_3$ .

C. Cemented carbide turning tool inserts of the type CNMG120408-PM with the composition 5.48 wt-% Co, 3.30 wt-% Ta, 2.06 wt-% Nb, 2.04 wt-% Ti and rest WC produced from powder manufactured with conventional ball milling techniques with the same CW-ratio and almost the same average WC-grain size as insert A and B were coated with the same coating as insert A and B.

Inserts from A, B and C were compared in a external longitudinal turning test with cutting data 240 m/min, a dept. of cut of 2 mm, and a feed per tooth equal to 0.7 mm/revolution. The work piece material was SS 2541 with an hardness of 300 HB and a diameter of 160 mm. The wear criteria in this test was the measure of the maximum flank wear after 5 min in cutting time, which reflects the resistance against plastic deformation.

The following results were obtained

max. flank wear,  $\mu\text{m}$

A	28
B	35
C	38

Since the general toughness behaviour was similar it is clear that both insert A produced from Co-coated WC, and insert B produced from uncoated WC both according to the invention, performed better than insert C produced with conventional techniques.

### Claims

1. A cemented carbide insert with excellent properties for machining of steels and stainless steels comprising WC and 4 - 25 wt-% Co in which the WC-grains have an average grain size in the range 0.2 - 3.5  $\mu\text{m}$  characterised in that the WC grains have a narrow grain size distribution in the range 0 - 4.5  $\mu\text{m}$ .

2. A cemented carbide insert according to the preceding claim comprising WC, 5 - 20 wt-% Co and 0 - 30 wt-% cubic carbide, preferably 0 - 15 wt-% cubic carbide, most preferably 0 - 10 wt-% cubic carbide such as TiC, TaC, NbC or mixtures thereof in which the WC-grains have an average grain size in the range 0.8 - 3.5  $\mu\text{m}$  preferably 1.0 - 3.0  $\mu\text{m}$  characterised in that the WC grains have a narrow grain size distribution in the range 0.5 - 4.5  $\mu\text{m}$ .

3. A cemented carbide insert according to claim 1 comprising WC and 10 - 25 wt-% Co, preferably 15 - 20 wt-% Co in which the WC grains have an average grain size 0.2 - 1.0  $\mu\text{m}$  characterised in a narrow grain size distribution of WC in the range 0 - 1.5  $\mu\text{m}$ .

4. A cemented carbide insert according to any of the preceding claim characterised in that the W-content in the binder phase expressed as the "CW-ratio" defined as

$$\text{CW-ratio} = M_s / \text{wt\%Co} * 0.0161$$

where  $M_s$  is the measured saturation magnetization of the sintered cemented carbide insert in kA/m and wt% Co is the weight percentage of Co in the cemented carbide shall be 0.82 - 1.0, preferably 0.86 - 0.96.

5. A cemented carbide insert according to any of the preceding claims characterised in that said insert is provided with a thin wear resistant coating.

6. A cemented carbide insert according to claim 5 characterised in that said coating comprises  $\text{TiC}_x\text{N}_y\text{O}_z$  with columnar grains followed by a layer of  $\alpha\text{-Al}_2\text{O}_3$ ,  $\kappa\text{-Al}_2\text{O}_3$  or a mixture of  $\alpha$ - and  $\kappa\text{-Al}_2\text{O}_3$ .

7. Method of making a cemented carbide cutting tool insert by mixing powders of WC, TiC, TaC and/or NbC, binder metal and



pressing agent, drying preferably by spray drying, pressing to inserts and sintering characterised in

- that a deagglomerated WC-powder with a narrow grain size distribution is used,

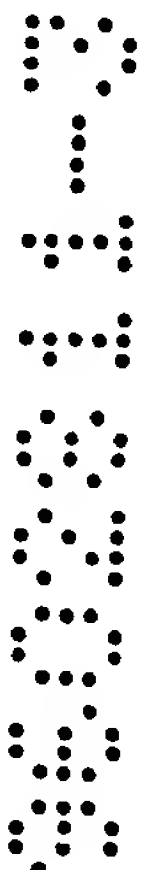
5 - that the powders of TiC, TaC and/or NbC are deagglomerated and

- that the mixing is wet mixing with no change in grain size or grain size distribution

10 8. Method according to claim 7 characterised in that in the WC-powder with a narrow grain size distribution the coarse grain tails  $> 4.5 \mu\text{m}$  and fine grain tails,  $< 0.5 \mu\text{m}$ , are eliminated by sieving such as in a jetmill-classifier.

15 9. Method according to claim 7 characterised in that in the WC-powder with a narrow grain size distribution the coarse grain tails  $> 1.5 \mu\text{m}$  is eliminated by sieving such as in a jetmill-classifier.

10. Method according to any of the claims 7-9 characterised in that the WC grains are coated with binder metal and deagglomerated prior to the mixing.



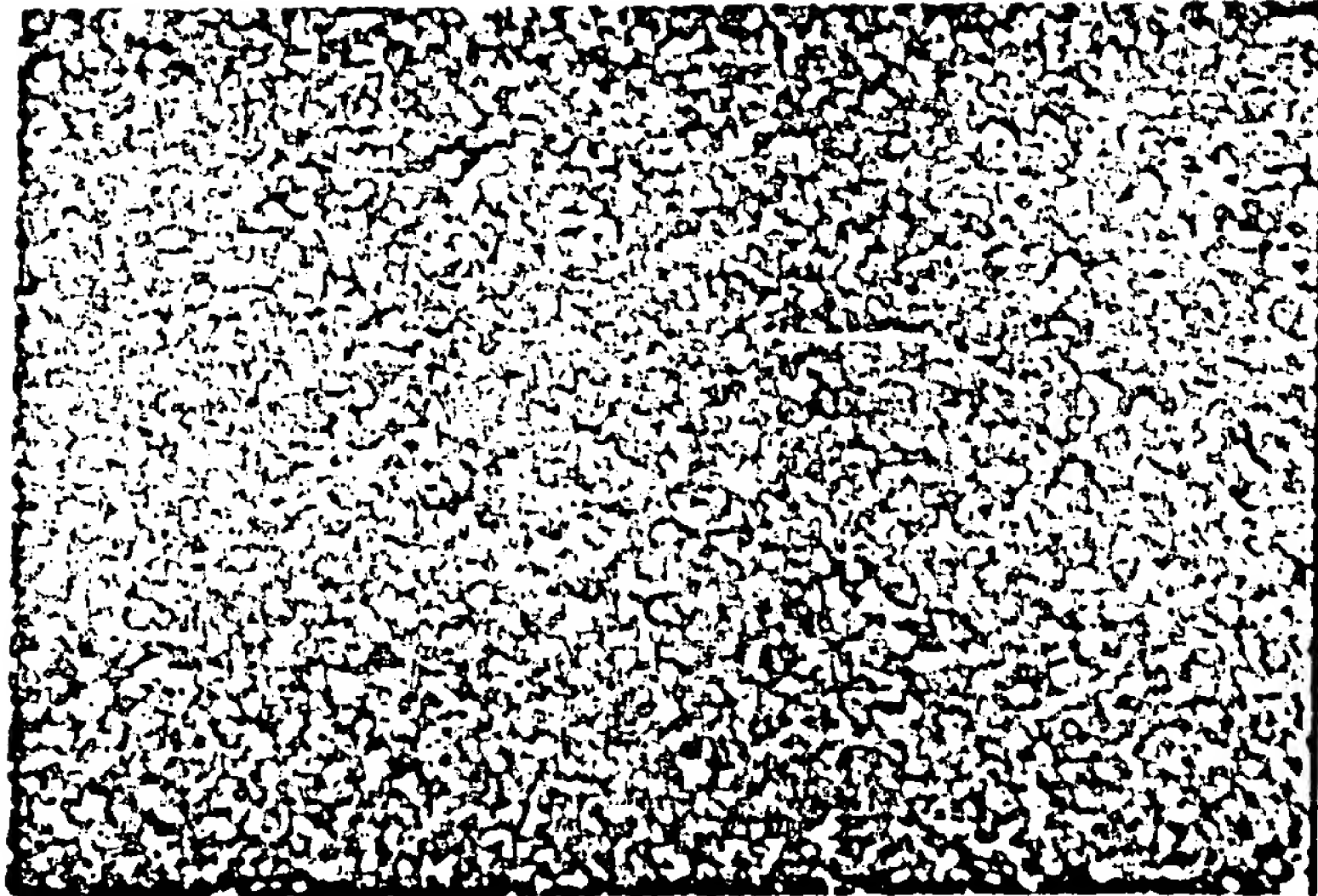
Abstract

The present invention relates to a cemented carbide insert with excellent properties for machining of steels and stainless steels. The cemented carbide comprises WC and 4 - 25 wt-% Co.

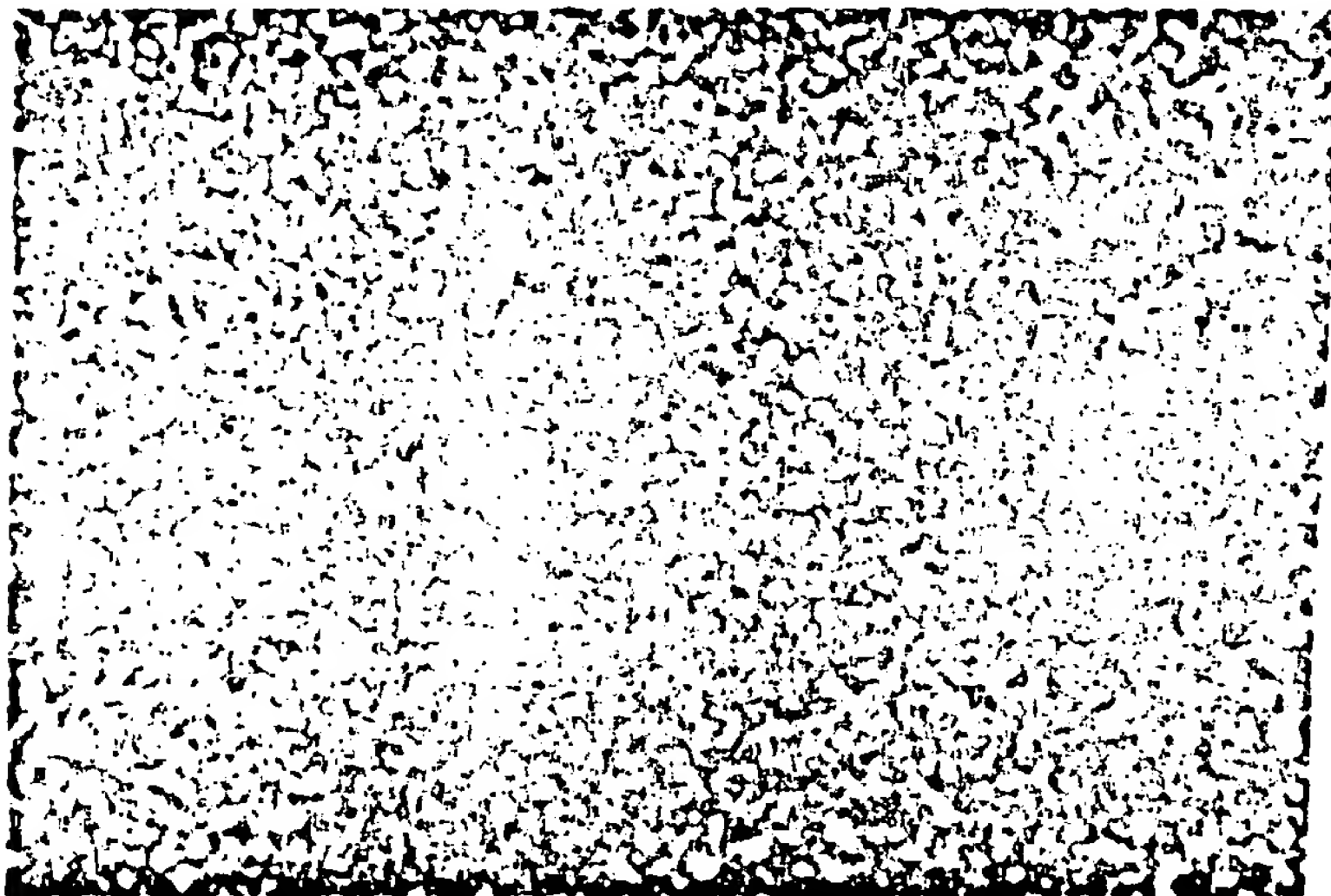
- 5 The WC-grains have an average grain size in the range 0.2 - 3.5  $\mu\text{m}$  and a narrow grain size distribution in the range 0 - 4.5  $\mu\text{m}$ .

- 10 According to the method of the invention a cemented carbide cutting tool insert is made by mixing powders of WC, TiC, TaC and/or NbC, binder metal and pressing agent, drying preferably by spray drying, pressing to inserts and sintering. The method is characterised in

- that a deagglomerated WC-powder with a narrow grain size distribution is used,
- 15 - that the powders of TiC, TaC and/or NbC are deagglomerated and
- that the mixing is wet mixing with no change in grain size or grain size distribution.



**Fig. 1**



**Fig. 2**

PATENT- OCH REGISTRERINGSVERKET

Beslutsdatum 1996-12-18

Patentavdelningen

Patentansökning nr 9602811-3

Rotel 522

Internationell klass (IPC)

C22C 029/08

Adressat:

SANDVIK AB PATENTAVDELNINGEN

811 81 SANDVIKEN

Sökande: Sandvik AB, 811 81 Sandviken SE.

Ombud: Sandvik AB Patentavdelningen. Ref: KWP-11123 SE.

Benämning: Cemented carbide insert for turning, milling and drilling.

Skriftligt svar skall ha kommit in till PRV senast 1997-11-19.

Om svar inte kommit in inom angiven tid, avskrivs ansökningen (jfr 15 § patentlagen).

## U T L Å T A N D E

På svenska språket avfattad beskrivning, patentkrav och sammandrag har inte ingivits i föreskrivna tre exemplar. De på svenska avfattade handlingarna skall, om de inte utgörs av vederbörligen styrkta översättningar, vara försedda med intyg om att deras innehåll har motsvarighet i de utländska handlingarna. Patentkraven bör vara försedda med mot ritningarna svarande hänvisningsbeteckningar inom parentes. Onödiga upprepningar i patentkraven bör undvikas. Skall ansökningen fullföljas måste svenska handlingar sändas in senast i samband med besvarandet av detta föreläggande.

Fullmakt för ombudet saknas.

Överlåtelsehandling saknas.

Den patentsökta uppfinningen avser ett inlägg av hårdmetall för metallbearbetning bestående av WC och 4-25% Co. WC-kornen uppvisar en medelkornstorlek på 0,2-3,5 µm med en smal kornstorleksfördelning inom 0- 4,5 µm. Verktyg med dessa inlägg uppvisar bättre skärande egenskaper än tidigare. Genom US 4923512 och US 3660050, se kraven, är det tidigare känt hårdmetallinlägg för skärande verktyg bestående av WC med upp till 25 % Co vars WC-korn har en medelstorlek på några µm. Den patentsökta uppfinningen skiljer sig härifrån endast genom uppgiften om smal kornstorleksfördelning.

Forts.

## U P P L Y S N I N G A R

Patentkrav får inte ändras så att det kommer att innehålla något som inte framgår av grundhandlingarna. Ändras patentkrav så att nya bestämningar tillkommer, skall samtidigt anges var motsvarighet finns i grundhandlingarna. Ändrade handlingar skall inges i två exemplar.

Kornstorleksfördelningen definieras endast genom intervallet, vilket ej avgränsar den patentsökta uppfinningen mot det härigenom kända hårdmetallinlägget. Det får emellertid anses ligga nära till hands för fackmannen att avlägsna större korn, så att en smal fördelning erhålles, varför kraven 1-3 saknar erforderlig uppfinningshöjd.

Det patentsökta sättet enligt kraven 7-10 saknar de särskilda tekniska särdragen från krav 1, varför en enhetlig uppfinning ej kan anses föreligga.

Det patentsökta sättet skiljer sig ej väsentligt från vad som tidigare är känt genom SE 502754 och WO95/26245, varför dessa krav ej anger något patenterbart.

I tjänsten

  
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LTI